ASHRAE 62.2 for Existing Dwellings

MIAQC Conference
February 2011

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What We Will Talk About

- Natural air leakage doesn't cut it.
- Fundamentals of ASHRAE 62.2.
- Secondary requirements of Standard.
- Determining whole-building ventilation.
- Whole-building ventilation options.
- Measuring ventilation performance.
- Suggested work sequence.
- Sizing examples.

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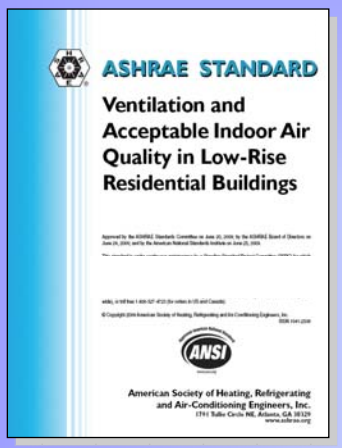
ASHRAE 62.2-2010



Currently MUBEC requires ASHRAE 62.2-2007 for new dwellings.

The Maine low-income weatherization program will soon require ASHRAE 62.2-2010.

www.ashrae.org

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Scope of ASHRAE 62.2-2010

- "... applies to spaces intended for human occupancy within single-family houses and multifamily structures of three stories or fewer above grade, including manufactured and modular houses.
- "... considers chemical, physical, and biological contaminants that can affect air quality. Thermal comfort requirements are not included in this standard."
- "While acceptable IAQ is the goal of this standard, it will not necessarily be achieved even if all requirements are met."

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Acceptable IAQ Defined as. . .

- ". . . air toward which a substantial majority of occupants express no dissatisfaction with respect to odor and sensory irritation and in which there are not likely to be contaminants at concentrations that are known to pose a health risk."

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Require ASHRAE 62.2-2010

- *Workforce Guidelines for Home Energy Upgrades*, DOE/NREL, 2011.
- *Healthy Indoor Environment Protocols for Home Energy Upgrades*, EPA, 2010.
- Weatherization Health and Safety Guidance (Weatherization Program Notice 11-6).
  - Calls for use of ASHRAE 62.2-2010 by January1, 2012.
- *Home Energy Auditing Standard*, BPI-101, Building Performance Institute, 2010.*

*BPI-101 specifically calls for the use of ASHRAE 62.2-2007, but allows the alternative compliance supplement path. This effectively aligns it with ASHRAE 62.2-2010.

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Residential IAQ Fundamentals

- Source control.
- Air leakage/natural ventilation.
- Local ventilation.
  - Exhaust the worst air in the house.
- Whole-building (dilution) ventilation.

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Natural Air Leakage Alone Doesn't Cut It!

- Air leakage-only ventilation leads to:
  - Too much outdoor air at low outdoor temperatures (below 45 degrees).
  - Too little outdoor air at warmer temperatures (above 45 degrees).
  - Unpredictable outdoor air ventilation rates, thus, substandard IAQ.
  - Wasted energy.

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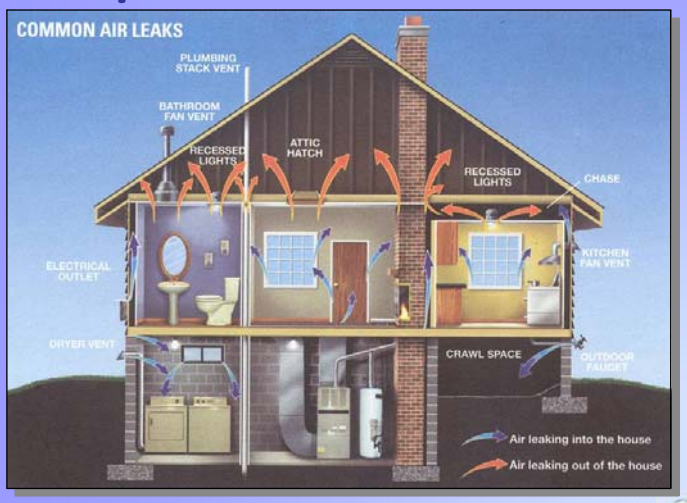
Typical Air Leakage Paths



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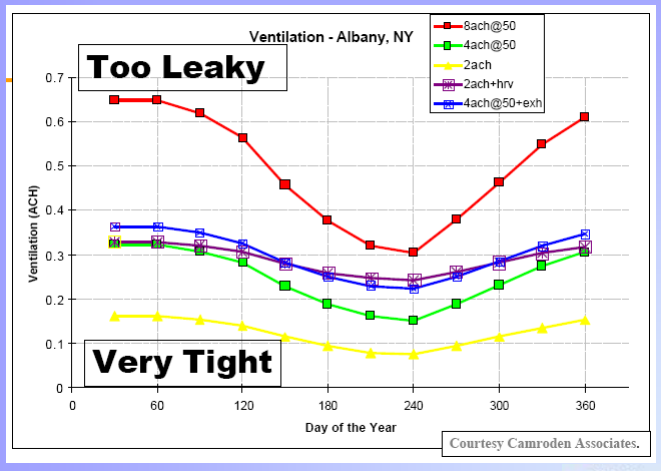
Daily Variation of Air Leakage



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So, What To Do?

- ~~Follow ASHRAE 62-1989 for acceptable IAQ?~~
  - ~~This standard has been obsolete since 2007 when ASRHAE 62.2 was first released.~~
- Follow ASHRAE 62.2-2010 for acceptable IAQ.
  - This latest version of the Standard makes compliance easier in existing dwellings.

Click 1

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ASHRAE 62.2-2010

- Requires local ventilation in bathrooms and kitchens in all homes.
- Requires whole-building ventilation in all new and the majority of existing homes.
- And more. . .

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Fundamentals of Standard ASHRAE 62.2

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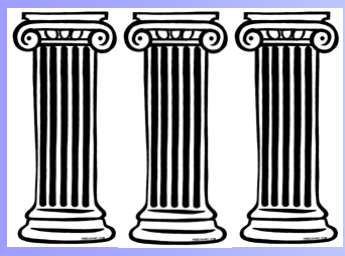
Three Pillars of the Standard

- Local ventilation.
- Whole-building ventilation.
- Source control.



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Local Ventilation

- Exhaust the worst air in the dwelling as quickly as possible.
  - Bathrooms.
  - Kitchens.
  - Garages.
  - Crawlspaces.

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ASHRAE 62.2 Requirements

- Local exhaust fans must be installed in bathrooms and kitchen.
  - Bathrooms (not half bathrooms)
    - 50 CFM on-demand, or
    - 20 CFM continuous.
  - Kitchen
    - 100 CFM on-demand*, or
    - 5 ACH, based on kitchen volume.
      - 12' x 14' x 7.5' kitchen requires 105 CFM.

*Vented range hood required if exhaust fan flow rate is less than 5 kitchen air changes per hour.

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Whole-Building Ventilation

- Dilution ventilation – bringing in enough outdoor fresh air to dilute the bad stuff already in the indoor air.
- Effectiveness depends on the quality of the outdoor air and the concentration of pollutants in the indoor air.

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ASHRAE 62.2 Requirements

- Whole building ventilation:
  - "A mechanical exhaust system, supply system, or combination thereof shall be installed for each dwelling unit to provide whole-building ventilation. . ."
  - Ventilation based on the equation and table on next slide.
    - These CFM requirements are for whole building continuous ventilation.

Source: ASHRAE 62.2-2010, page 4

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ASHRAE 62.2 Requirements

Minimum Ventilation Air Requirements, CFM

Floor Area (ft^2)	Bedrooms				
	0 - 1	2 - 3	4 - 5	6 - 7	>7
<1500	30	45	60	75	90
1501 - 3000	45	60	75	90	105
3001 - 4500	60	75	90	105	120
4501 - 6000	75	90	105	120	135
6001 - 7500	90	105	120	135	150
>7500	105	120	135	150	165

$$Q_{fan} = 0.01A_{floor} + 7.5(N_{bedroom} + 1)$$

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ASHRAE 62.2 Requirements

- Or, use $Q_{fan} = 0.01A_{floor} + 7.5(N_{bedroom} + 1)$
  - Assumes two occupants in master bedroom and one in the other bedrooms. Over this density, increase ventilation by 7.5 cfm/person.
  - Whole building, intermittently operating ventilation may be used under some conditions for compliance.
  - Ventilation air must come directly from the outdoors.
  - Credit is allowed for envelope air leakage in existing houses, based on ASHRAE 136-1993*.

A = conditioned space; "the part of the building that is capable of being thermally conditioned for the comfort of occupants." (ASHRAE 62.2, p.3)

A Method of Determining Air Change Rates in Detached Dwellings

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ASHRAE 62.2 Requirements

- The whole building ventilation requirements of the Standard may be satisfied by intermittent operation, but in some cases, this is not a good alternative because:
  - May require high CFM fan flow rates.
  - Control of fan must provide consistent percentage on-times.

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Programmable Control

A control for whole building intermittent fans

Air Flow adjustable from 40 to 100% of capacity in 16 increments for background ventilation rate.

Built-in Timer programmed at installation in multiples of 5 minutes for a 12 or 24 hour cycle.

Boost to full speed for 20 minutes by pressing button. Pressing again drops speed to background rate.

Airetrack™ by Tamarack

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ASHRAE 62.2 for Existing Dwellings

Alternative Compliance Supplement (Path) for Existing Dwellings, Appendix A of 62.2-2010

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ASHRAE 62.2 for Existing Dwellings

Alternative Compliance Path

- For existing dwellings only.
- Provides alternative methods of meeting local exhaust requirements in kitchens and bathrooms that do not have the existing LOCAL fans required by ASHRAE 62.2-2010.

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ASHRAE 62.2 for Existing Dwellings

Alternative Compliance Path

- In each room where local ventilation should be, determine deficit relative to required rate:
  - How much less than 50 cfm in bathrooms.
  - How much less than 100 cfm in kitchens.
- For each room with a deficit, reduce room's deficit by 20 cfm if that room has an openable window.

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Alternative Compliance Path

- Add up deficits and divide by 4.
- Add the result to the whole-building ventilation requirement.
  - This becomes the new whole-building ventilation requirement.

Calculated before infiltration credit

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Alternative Compliance Path

- For existing fans being used, sound and ducting requirements of 62.2 are not applicable.
- Must measure flow if ratings don't exist or duct sizing can't be verified.
  - If only have rating at 0.10 in. IWC but not 0.25 in. IWC, can reduce rating at 0.10 in. IWC by 25%.

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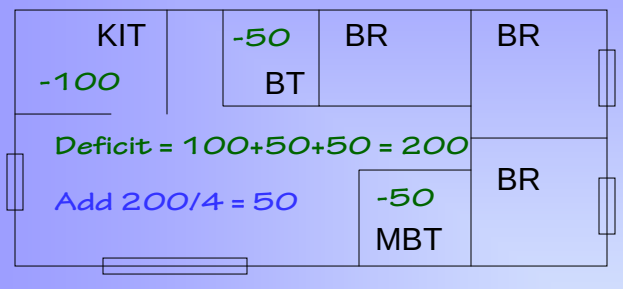
ASHRAE 62.2 for Existing Dwellings

Alternative Compliance Path

- Example #1: 3 BR, 1500 sq. ft. house



Whole-house requirement = 45 + 50 = 95 cfm

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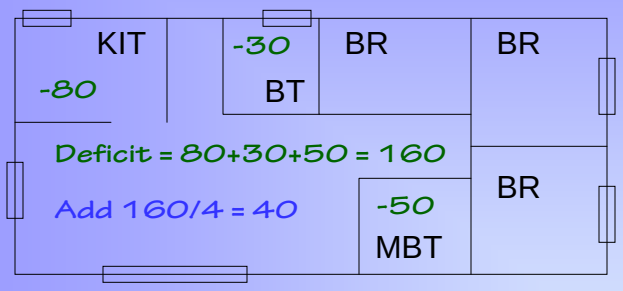
ASHRAE 62.2 for Existing Dwellings

Alternative Compliance Path

- Example #2: 3 BR, 1500 sq. ft. house



Whole-house requirement = 45 + 40 = 85 cfm

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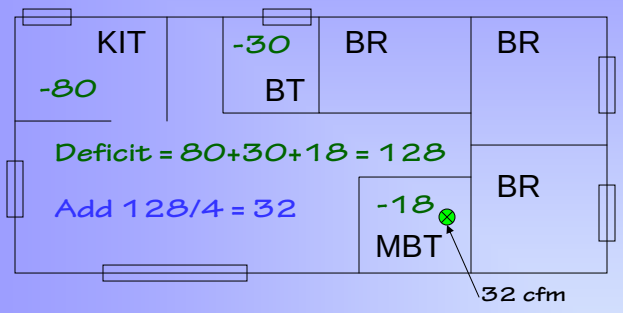
Alternative Compliance Path

- Example #3: 3 BR, 1500 sq. ft. house



Whole-house requirement = 45 + 32 = 77 cfm

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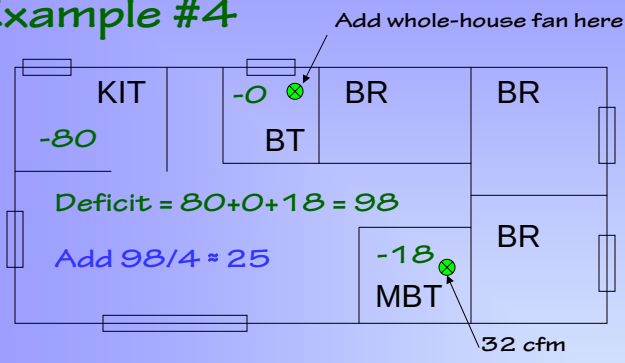
Alternative Compliance Path

- Example #4



Whole-house requirement = 45 + 25 = 70 cfm

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Infiltration Credit for Existing Dwellings

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ASHRAE 62.2 Requirements

- Infiltration credit calculation for dwellings "built prior to the application of this standard".[1] This means existing dwellings.

If:
Natural Infiltration > 2A/100
Then:
Infiltration credit = 0.5 (Natural Infiltration – 2A/100)

A = occupiable floor area in ft^2

[1] ASHRAE 62.2 - 2010, page 4, for whole building ventilation

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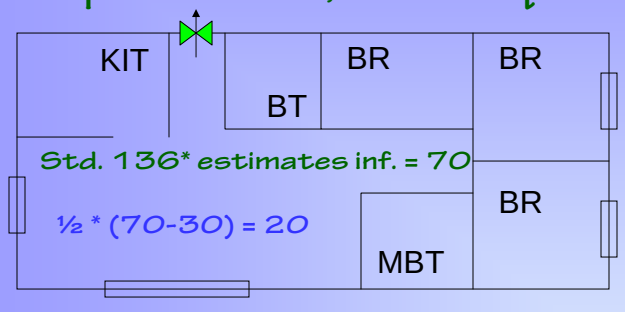
ASHRAE 62.2 for Existing Dwellings

Infiltration Credit

- Example #5: 3 BR, 1500 sq. ft. house



Std. 136* estimates inf. = 70

½ * (70-30) = 20

Whole-building requirement = 45 - 20 = 25 cfm

*A Method of Determining Air Change Rates in Detached Dwellings

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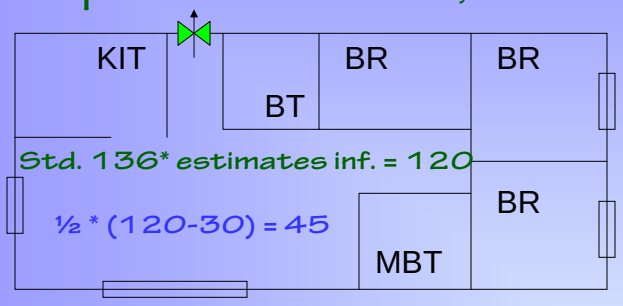
Infiltration Credit

- Example #6: same house, but leakier



Whole-house requirement = 45 - 45 = 0 cfm

*A Method of Determining Air Change Rates in Detached Dwellings

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Source Control

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Source Control

- Less control in existing dwellings than in new dwellings.
- Control sources of pollution, including:
  - Moisture.
  - Formaldehyde.
  - Radon.
  - Products of combustion.
  - Volatile organic compounds.
- *This is a big and important topic that is beyond the scope of this training.*

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Additional Selected Requirements of Standard 62.2

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Attached Garages

- Must prevent migration of contaminates to the adjoining occupiable space.
  - All joints, seams, penetrations, and openings must be sealed or gasketed.

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Instructions and Labeling

- Provide to owner or occupant of dwelling unit:
  - Information on ventilation systems installed;
  - Instructions on proper operation; and
  - Instructions on proper maintenance.
- Controls shall be labeled as to their function.

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Ventilation Operation Manual

- Customer education is very important.
- Make up an operation manual for occupants. Have extra copies available.
  - Purpose of ventilation.
  - Proper operation of ventilation system, whole building and local.
  - Maintenance suggestions.

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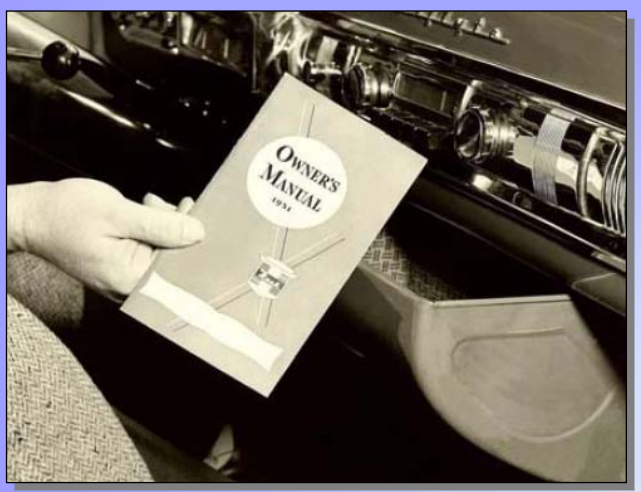
Provide Owner's Manual



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Clothes Dryer Venting

- Must be exhausted to the outdoors.

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Sound Ratings for Fans

- The sound ratings of installed ventilation equipment shall meet the requirements of the Standard.

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First, What is a Sone?

Sone Chart

Sound Level Situation	Sone Level	How We feel
Traffic Noise	8.0 7.0 6.0 5.0	Conversation with added noise
TV/Radio	4.0 3.0	Normal Conversation
Calm Office	2.0 1.5	
Night in Suburbs	1.0	Comfortable Zone Free From Noise
Rustling Shrubs	0.5	

The sone scale is a linear method of measuring loudness.

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Maximum Fan Sound Ratings		
New Replacement Fans	*Existing Retained Fans***	*Maximum Sound Rating*
Local bath, on-demand		3.0 sones or 50 dBA*
	Local bath, on-demand	N/A
Local bath, continuous		1.0 sone or 30 dBA*
	Local bath, continuous	N/A
Local kitchen, on-demand		3.0 sones or 50 dBA*
	Local kitchen, on-demand	N/A
Local kitchen, continuous		1.0 sone or 30 dBA*
	Local kitchen, continuous	N/A
Whole-building		1.0 sone or 30 dBA*
	Whole-building	1.0 sone or 30 dBA*

*A-weighted decibels measured at 5 feet from fan grille.
**Valid only if Appendix A, 62.2-2010 is used.
Source: ASHRAE 62.2-2010.

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Ventilation Ducting

- If outside thermal envelope, R-8.
- Rigid ductwork preferred.
- Flexible duct specifications.
- Support properly.
- Size according to table on next slide.

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Not good!

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Determining Whole-Building Ventilation

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Three Known Sizing Methods

- The whole-building ventilation is complicated to size for an existing house because of the infiltration credit.
  - ZipTest Pro^3 for the Texas Instruments TI-89 calculator (R.J. Karg Associates).
  - ResVent 62.2 for the iPhone, iPad, and iPod touch (R.J. Karg Associates).
  - Appendix C of Ventilation Chapter in *Workforce Guidelines for Home Energy Upgrades*, DOE/NREL, 2011 (details of the required math).

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ZipTest Pro^3

www.karg.com/software.htm

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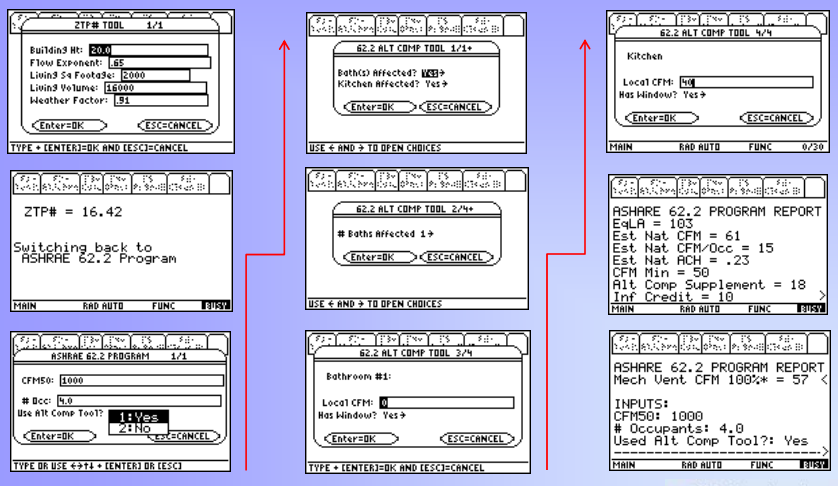
ZipTest Pro^3



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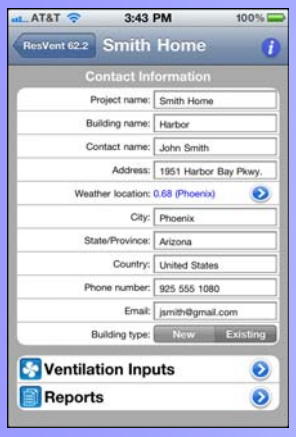
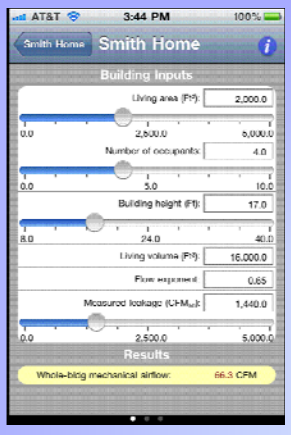
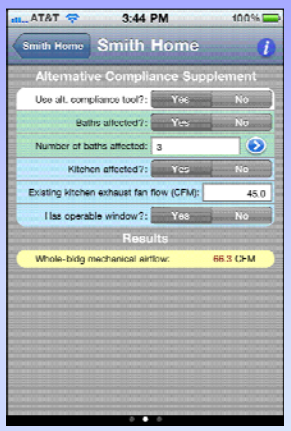
ResVent 62.2







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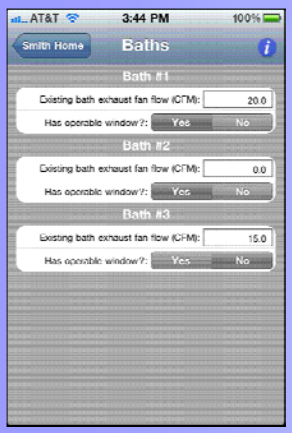
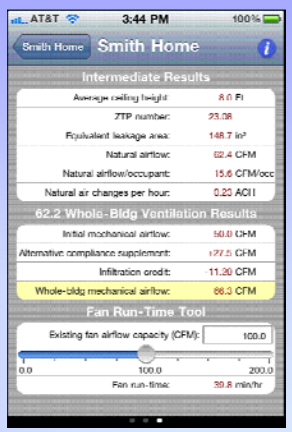
ResVent 62.2





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Whole-Building Ventilation Options

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Ventilation System Types

- System types:
  - Supply-only (not good for Maine)
  - Exhaust-only
    - Separate exhaust fan(s)
    - Ducted in-line fan
  - Balanced system
    - HRV (sensible heat recovery)
    - ERV (sensible and latent heat recovery)

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Exhaust-Only Ventilation

- Exhausting unit(s) only, no supply ventilation.
  - Exhaust fan serving one exhaust point.
  - In-line fan unit serving one or more exhaust points.
  - Creates negative pressure in building.
    - Pulls pollutants from garage, etc.
    - Backdrafting potential.
  - Source of supply air?

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Exhaust-Only

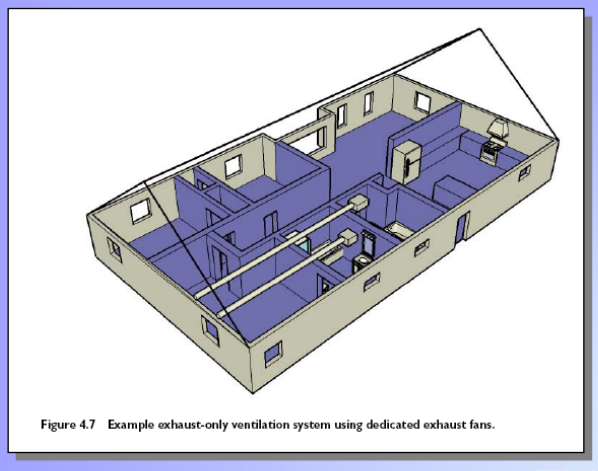

Figure 4.7 Example exhaust-only ventilation system using dedicated exhaust fans.

Source: 62.2 User's Manual ©2006 ASHRAE

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Panasonic WhisperGreen

- Speed-compensated for static pressure
- Constant run CFM from 30 to 70, switch to 80 CFM max.

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Bathroom or Hall Exhaust Fans

Photos courtesy of Wisconsin Weatherization Program

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Kitchen Exhaust Fans

100 CFM, or
5 ACH of kitchen volume.

Venmar S1311LS range hood with 40 CFM background & 75, 160, and 270 CFM on-demand speeds.

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Exhaust-Only, In-Line

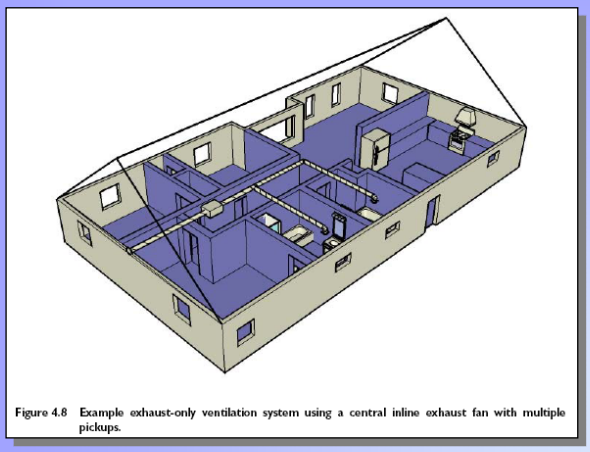

Figure 4.8 Example exhaust-only ventilation system using a central inline exhaust fan with multiple pickups.

Source: 62.2 User's Manual ©2006 ASHRAE

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In-line Exhaust Fans

Photos courtesy of Wisconsin Weatherization Program

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Balanced Ventilation

- Exhaust and supply ventilation are approximately equal cfm.
  - Heat Recovery Ventilator (HRV)
    - unit transfers sensible heat only with no humidity transfer.
  - Energy Recovery Ventilator (ERV)
    - Unit transfers sensible and humidity.

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Balanced System

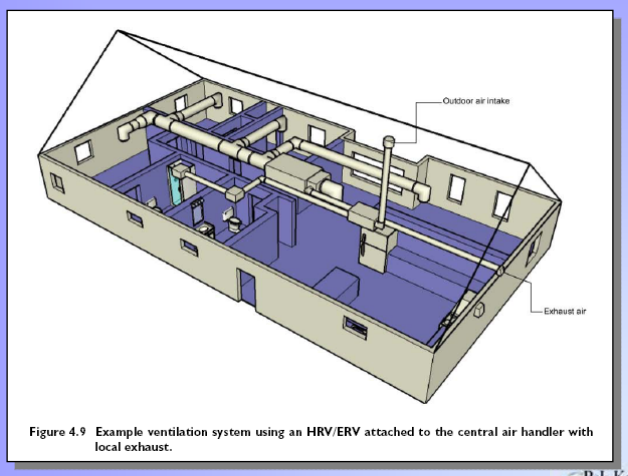

Figure 4.9 Example ventilation system using an HRV/ERV attached to the central air handler with local exhaust.

Source: 62.2 User's Manual ©2006 ASHRAE

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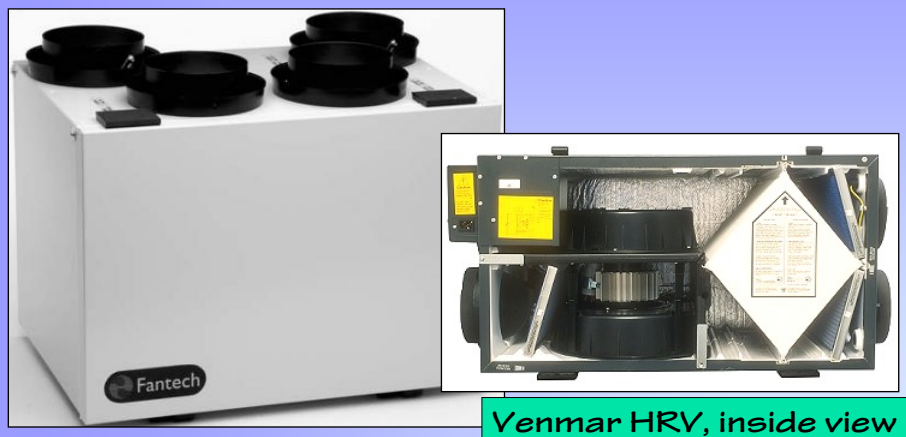
Heat Recovery Ventilators (HRV)



Venmar HRV, inside view

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ASHRAE 62.2 for Existing Dwellings

HRV & ERV aren't Practical When:

- Energy is cheap.
- House is very leaky.
- There is no place for ducts.

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Hybrid Systems

- Exhaust fans(s) with passive air inlets.
- Exhaust fan(s) with supply fan(s) for make-up air.
- Outdoor air ducted to air handler return trunk (pressurizes building).
- Balanced ventilation tied into heating/AC duct system.

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Measuring Ventilation Performance

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Exhaust Fan Flow Meter

Measurement range from 10 to 124 CFM (1 to 8 Pascals)

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Exhaust fan flow meter use

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Exhaust Fan Flow Meter Chart

Meter Pressure (Pa)	Flow (CFM) E1	E2	E3	Meter Pressure (Pa)	Flow (CFM) E1	E2	E3
0.6	34	16	8	4.4	92	43	21
0.8	39	19	9	4.6	94	44	22
1.0	44	21	10	4.8	96	45	22
1.2	48	23	11	5.0	98	46	23
1.4	52	25	12	5.2	100	47	23
1.6	55	26	13	5.4	102	48	23
1.8	59	28	14	5.6	103	49	24
2.0	62	29	14	5.8	105	50	24
2.2	65	31	15	6.0	107	51	25
2.4	68	32	16	6.2	109	52	25
2.6	71	33	16	6.4	111	52	25
2.8	73	35	17	6.6	112	53	26
3.0	76	36	17	6.8	114	54	26
3.2	78	37	18	7.0	116	55	27
3.4	81	38	19	7.2	117	56	27
3.6	83	39	19	7.4	119	56	27
3.8	85	40	20	7.6	121	57	28
4.0	87	41	20	7.8	122	58	28
4.2	90	42	21	8.0	124	59	28

Exhaust Fan Flow Meter
The Energy Conservatory
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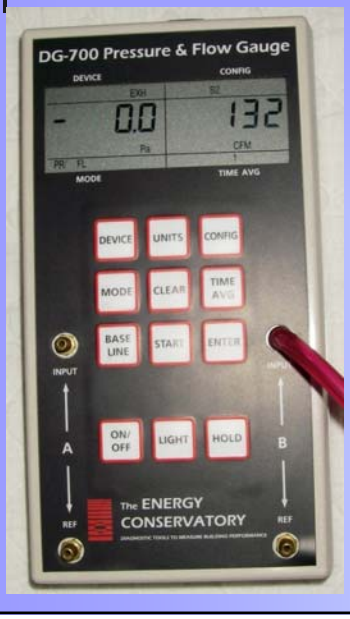

Or, measure directly with The DG-700

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Anemometer

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Suggested Work Sequence

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Suggested Work Sequence

1) Inventory existing fans (measure flow).
   a) Local
      i. Bathrooms (50 CFM on-demand, or 20 CFM continuous).
      ii. Kitchen (100 CFM on-demand, or 5 ACH, based on kitchen volume).
   b) Whole building?
   c) Changes or additions needed?
2) Determine the maximum ventilation amount:
   a) From simple equation or corresponding chart, plus
   b) Alternative Compliance Supplement based on post-weatherization conditions.

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Suggested Work Sequence

4) Conduct as-is blower door test to find CFM_{50} of dwelling.
5) Post-weatherization modeling
   a) Estimate post-weatherization CFM_{50}.
      i. 10% of volume is ~ 6 ACH_{50}.
      ii. 15% of volume is ~ 10 ACH_{50}.
   b) Estimate post-weatherization depressurization.
      i. Are existing combustion appliances affected under continuous operation? Intermittent operation? (Depressurization will be greater under intermittent operation.)

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Suggested Work Sequence

6) After weatherization is completed, measure actual CFM_{50} and set required CFM of whole-building ventilation fan with variable-speed control.
7) Perform combustion safety testing.
8) Verify proper operation of all local and whole building ventilation equipment.
9) Job completed.

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Commissioning

- Check controls.
- Measure airflows for all installed ventilation equipment.
- Check filters.
- O&M manual left with client?
- Client education?

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What We Talked About

- Natural air leakage doesn't cut it.
- Fundamentals of ASHRAE 62.2.
- Secondary requirements of Standard.
- Determining whole-building ventilation.
- ventilation options.
- Measuring ventilation performance.
- Suggested work sequence.
- Sizing examples.

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Function Relationships

If this goes up ↑	Whole-Building Ventilation goes
Weather factor	down ↓
Square feet of dwelling	up ↑
Number of occupants	up ↑
Building height	down ↓
Volume	N/A (only affects ACH)
Flow exponent	up ↑
CFM50 (infiltration credit)	down ↓
Alternative compliance path	up ↑

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